Application of Zeeko's Novel Random Tool Path for Improvement of Surface PSD, Phase I

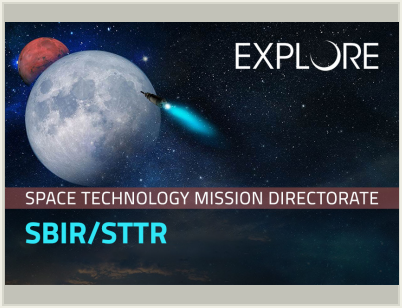
Completed Technology Project (2009 - 2009)

Project Introduction

A well known problem in the fabrication of aspheric optical surfaces lies in surface irregularities inherent in the figuring process. Low-spatial frequency errors (figure errors) cause distortion in the system wavefront, resulting in degradation of the point spread function. Mid-spatial frequency errors cause small-angle scattering of light (flare), which reduces image contrast. High-spatial frequency errors scatter light out of the optical beam over larger angles, reducing the energy throughput in an optical system. The Zeeko Precessions polishing is a sub-aperture process that has been developed for the control of form and texture in the production of aspheric and other optical surfaces. The Precessions process is deterministic and provides dramatic reductions in production time due to its high removal rate and repeatability. Similar to other sub-aperture finishing processes, the Precessions process is prone to leave mid-spatial frequency defects on the surface. Zeeko has developed a unicursal random tool path that does not follow a regular pattern and is non-crossing. The goal of this Phase I project is to expand on promising initial results obtained by using the random tool path. The results generated by the research project will be used to demonstrate and improve the performance of the Zeeko polisher for this critical application. We propose a study that employs the polishing methodology used by Zeeko Technologies to determine whether trial procedures using the Zeeko approach can effectively correctively finish an optic without inducing unwanted frequencies onto the surface of the part.

Anticipated Benefits

In addition to NASA missions, other industries that require large high precision optical surfaces could benefit from the successful completion of this Phase I project such as the semiconductor manufacturing industry. Within this industry, next generation EUV (Extreme Ultraviolet Lithography) and the polishing of semiconductor wafers and photomask substrates could gain from the proposed research on PSD control. Also the proposed research has the potential to benefit high power laser systems in both the need to utilize laser power efficiently and to mitigate safety risks associated with even a small percentage of the laser energy propagating in the wrong direction.



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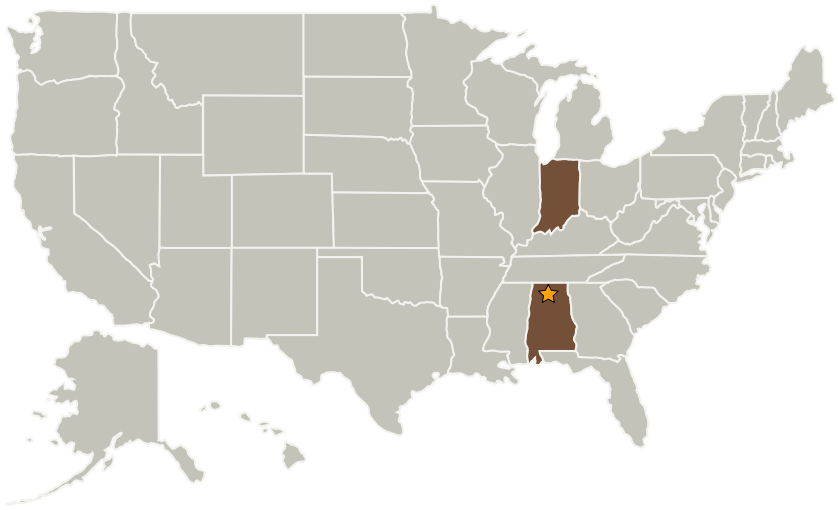
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Zeeko Technologies, LLC	Supporting Organization	Industry	West Lafayette, Indiana

Primary U.S. Work Locations	
Alabama	Indiana

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Ron Eng

Principal Investigator:

John Kelchner

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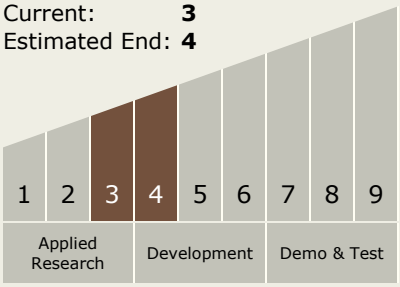
Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes